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Interactive e-module using Zoom Cloud Meeting platform to reduce misconceptions on salt hydrolysis material

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ABSTRACT

This study aimed to determine the effectiveness of using an interactive e-module to reduce students' misconceptions on salt hydrolysis material at grade XI in senior high school. This study implemented a pre-experiment with one group pretest-posttest research design, which utilized one class as the experimental class. Samples were selected by using purposive sampling technique, and it was obtained one class as the experimental class, namely class XI in State Madrasah Aliyah 1 Pekanbaru, Riau, Indonesia. Before giving the treatment, the sample was administered a pretest and after the treatment, they were given a posttest. The pretest and posttest questions occupied three-tier multiple choice questions. The reduction of misconceptions on Salt Hydrolysis material after using the interactive e-module was 16.21%. The study found that interactive e-modules effective to reduce misconceptions on salt hydrolysis material was significant.

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1. INTRODUCTION

Learning in the 21st century combines knowledge, thoughts, innovation skills, media, literacy, Information and Communication Technology (ICT) and real life experiences in the learning process. This combination allows to stimulate and encourage students to focus on achieving value or meaning to develop new skills [1], [2]. The 21st century is marked by the development of information technology [3]. The integration of technology in all areas of life causes the human interaction increasingly reliant on technological developments, indicated by the increasing interaction of humans with computers and the internet. As a result, changes occur rapidly and unpredictable in all aspects of life, such as the fields of knowledge, economy, transportation, technology, communication, education and others [4], [5]. Advances in science and technology have an effect on the use of teaching aids at schools and in other educational institutions. At this time, learning at schools begins to be adjusted to the development of science and technology, which results in changes and shifts in the educational paradigm. In order for effective teaching to occur, a teacher must provide various ways to address all students' learning needs [6]; one of which is by using information technology.

Using information technology for learning has become a necessity and demand in the globalization era [7]. Technology helps students learn self-extracting information skills, actively use cognitive structures from memory, thinking, imagination, and can be designed for intensive personality development in terms of students' organizing processes [8]. In accordance with the demands of 21st century learning, students must be capable of solving various problems by thinking creatively and using technology [1]. Each student has a

different ability to solve problems, especially the ability to discuss a concept. Students possess a concept carried as initial knowledge, which is called preconception. The students' preconceptions are sometimes different from the actual concept according to experts. For example, the students have different conceptions in accepting the concept, so it is possible that some students have a wrong conception towards a concept; this is called misconception [9]. Misconceptions can occur due to differences in the construction of knowledge of each individual and environment (peers, family, society, literature, teachers, and teaching methods) [10]. The students' misconceptions may result from the students themselves, teachers, textbooks, contexts, and learning methods. In addition, there are certain subject characteristics that are difficult for students to understand so that students try to interpret or create their own concepts. This sometimes does not match the actual concept; as a result, it creates wrong concepts in the minds of students [11].

In this study, students' misconceptions were investigated in the chemistry subject, particularly on salt hydrolysis by using a three-level multiple choice diagnostic test [12]. This test was chosen for it involved three levels of questions. The first level was an ordinary multiple choice question while the second level stated the reasons for the answers at the first level. Finally, the third level included students' confidence in the answers given on the two previous levels [13]. The students who answered correctly and were sure of their answers indicated that they really understood the concept learned. Meanwhile, the students who were sure of the answer even though the answer was wrong showed that they had a misconception. On the other hand, the students who answered erroneously and were not sure of the answer implied that they did not experience a misconception, but lack of knowledge. The advantages of a three-level multiple choice diagnostic test are that it can: 1) diagnose misconceptions experienced by students more deeply, 2) determine parts of the material that require more emphasis during learning, 3) plan for better learning to help reduce students' misconceptions [14]. Salt hydrolysis material was chosen as the object in this study because this material not only was limited to clearly observed concepts (concrete concepts) but also discussed abstract and complex concepts, as well as concepts involving symbolic representations [15].

Many attempts have been conducted to reduce misconceptions, such as studies conducted by implementing the cognitive conflict approach [16], the use of animation modules and media [17], the development of discovery-inquiry learning models [18], the use of interactive multimedia [19], and application of the Predict, Discuss, Explain, Observe, Discuss, and Explain (PDEODE) collaborative strategy [20]. Unfortunately, these studies have not shown significant results to reduce material misconceptions. In this study, the implementation of Interactive E-Module with Zoom Cloud Meeting platform was carried out to reduce students' misconceptions on online learning. It was hoped that this E-Module could be implemented as an independent learning resource to help students improve their cognitive competence or understanding. E-Module eased the students to learn a material since it was easy to carry anywhere and anytime [21]-[23].

In this study, the E-module was designed by using the Kvisoft Flipbook Maker application program. This program was used because its digital publication document view looks like a digital magazine which was varied, innovative, and efficient [24]. This application assists the learning process due to its features focusing not only on writings but also motion animations, videos, and audios which allow interactive and interesting learning media; as a result, the learning process is no longer monotonous [25]. The results of this study can be implemented in learning in the current pandemic conditions (Covid-19) which have affected the world including Indonesia. As the world health authorities, WHO has emphasized to stop outdoor activities and activities involving the crowd, including face-to-face learning that gathers a large number of students in the classroom [26]. For this reason, using digital technology allows students and teachers to perform the distance learning in which both students and teachers conduct the learning process from home [27]. A form of learning that can be used as a solution during the COVID- 19 pandemic is online learning using interactive e-module media products so that teachers can present information in innovative ways and can motivate students to study harder [28].

2. RESEARCH METHOD

This study was conducted at State Madrasah Aliyah 1 Pekanbaru, Riau, Indonesia in the even semester of the academic year 2019/2020. The method of this study was a pre-experimental research method with one group pretest-posttest research design [29]. In this design, the sample was given a pretest before the treatment and a posttest at the end of the study. The pretest was administered to determine the students' initial ability on salt hydrolysis material. After that, the students were taught by using interactive e-module teaching materials, and at the end of learning, the students were given a posttest to determine their final ability after using interactive e-module teaching materials in the learning process. The pretest and posttest questions utilized three-tier multiple choice questions. The research design can be seen in Table 1.

Table 1. The design of one group pretest-posttest

Subject	Pre Test	Treatment	Post Test
1 group	O_1	X	O_2

Note :
O_1 : pretest score before giving the treatment
X : treatment
O_2 : posttest score after giving the treatment

The population in this study was students of grade XI at State Madrasah Aliyah 1 Pekanbaru while the samples were 33 students at grade XI in State Madrasah Aliyah Pekanbaru who were selected by using purposive sampling technique. The misconceptions were determined by using the following methods.

2.1. Scoring

The assessors of multiple choice questions at level I and II were carried out by using the scoring shown in Table 2.

Table 2. Score item points

Types of Questions	Score	Remark
Three-tier multiple choice	1	If the answer is correct
	0	If the answer is incorrect

2.2. The analysis of students' misconception identification test

The data of this study were quantitative data derived from the results of three-tier multiple choice diagnostic test. Based on these results, the sample was grouped into four categories. They are the students: 1) Who knew the concept; 2) Who did not know the concept; 3) Who guessed; and 4) Who experienced misconceptions. This grouping was made for each question [30]. For more details, the criteria of this grouping are displayed in Table 3.

Table 3. Criteria for grouping students' conceptions

Level 1	Level 2	Level 3 (CRI)	Decision
Correct	Correct	Sure	Knowing the Concept
Correct	Correct	Not Sure	Guessing
Correct	Incorrect	Sure	Misconception
Correct	Incorrect	Not Sure	Guessing
Incorrect	Incorrect	Sure	Misconception
Incorrect	Incorrect	Not Sure	Not Knowing the Concept
Incorrect	Correct	Sure	Misconception
Incorrect	Correct	Not Sure	Guessing

2.3. Calculating the percentage

The number of samples who had a concept were converted into a percentage based on the analysis of written test data by using the formula:

$$\%KC = \frac{KC}{N}\ x\ 100\% \quad (1)$$

$$\%NKC = \frac{NKC}{N}\ x\ 100\% \quad (2)$$

$$\%MC = \frac{MC}{N}\ x\ 100\% \quad (3)$$

$$\%GA = \frac{GA}{N}\ x\ 100\% \quad (4)$$

Note:
KC = the group of students who know the concept
NKC = the group of students who do not know the concept
MC = the group of students who show misconceptions
GA = the group of students who guess the answer
N = the number of students

The effectiveness of using this e-module was calculated by using SPSS V 23. Hypothesis testing in this study was conducted by using Wilcoxon test. If the value of Asymp.Sig. (2-tailed) was less than <0.05, Ha was accepted. The confounding variable in this study is that the internet problem is resolved by sending an e-module file via a flash disk before learning to use Zoom cloud meeting is carried out.

3. RESULTS AND DISCUSSION

Data of this study were quantitative data derived from the results of three-tier multiple choice diagnostic test. Based on these results, the samples were grouped into four categories: 1) Students who knew the concept; 2) Students who did not know the concept; 3) Students who guessed the answer; and 4) Students who experienced misconceptions. This grouping was made for each question. To be clearer, the criteria for this grouping can be seen in Table 3. Furthermore, the data used to determine the results of misconception reduction was the difference between the misconception percentage of posttest and pretest. This difference showed a decrease in misconceptions before and after learning about salt hydrolysis by using interactive e-modules.

3.1. Grouping misconceptions data

The results of grouping misconceptions in this study are presented in Table 4. It can be seen that of the 20 questions given shows a decrease in student misconceptions for each question. This happens because students when learning online using the zoom cloud meeting platform can interact with the teacher effectively.

Table 4. The percentage of students' misconceptions in pretest and posttest

Item No	Misconceptions before treatment	Misconceptions after treatment
1	30.30%	15.15%
2	33.33%	27.27%
3	21.21%	6.06%
4	39.39%	21.21%
5	33.33%	15.15%
6	36.36%	21.21%
7	39.39%	30.30%
8	39.39%	18.18%
9	33.33%	12.12%
10	51.51%	33.33%
11	45.45%	33.33%
12	48.48%	21.21%
13	45.45%	21.21%
14	33.33%	18.18%
15	39.39%	24.24%
16	42.42%	27.27%
17	36.36%	24.24%
18	39.39%	21.21%
19	36.36%	24.24%
20	39.39%	24.24%

3.2. The amount of misconception reduction

The amount of misconception reduction was utilized to see how much the reduction of misconceptions from the use of interactive e-module teaching materials on salt hydrolysis material at grade XI in State Madrasah Aliyah 1 Pekanbaru. Table 5 displays that the reduction of misconceptions of using interactive e-module teaching materials on salt hydrolysis at grade XI in State Madrasah Aliyah 1 Pekanbaru was 16.21%. A previous study was conducted by Purnamawati, *et al*. [31] found that there was a reduction in misconceptions through the application of E-Module based on Problem-Based Learning on ecology material for 47.18% at grade X in Batik high school 1 Surakarta.

Table 5. The percentage of misconception reduction

Item No	Pretest	Posttest	Reduction
1	30.30%	15.15%	15.15%
2	33.33%	27.27%	6.06
3	21.21%	6.06%	15.15
4	39.39%	21.21%	18.18
5	33.33%	15.15%	18.18
6	36.36%	21.21%	15.15
7	39.39%	30.30%	9.09
8	39.39%	18.18%	21.21
9	33.33%	12.12%	21.21
10	51.51%	33.33%	18.18
11	45.45%	33.33%	12.12
12	48.48%	21.21%	27.27
13	45.45%	21.21%	24.24
14	33.33%	18.18%	15.15
15	39.39%	24.24%	15.15
16	42.42%	27.27%	15.15
17	36.36%	24.24%	12.12
18	39.39%	21.21%	18.18
19	36.36%	24.24%	12.12
20	39.39%	24.24%	15.15
Average	38.17%	21.96%	16.21%

The reduction of misconceptions occurred because e-modules presented independent learning materials that were systematically arranged into the smallest learning units in order to achieve certain learnings presented in electronic formats such as animations, audios, and navigations which allowed users to be more interactive with the program. Electronic media accessed by students had different benefits and characteristics. From the benefits view, electronic media could make the learning process more interesting and interactive. Besides, it could be done anytime and anywhere, and it improved the quality of learning. As a result, it reduced students' misconceptions [32]. The cover of interactive e-module product on salt hydrolysis is seen in Figure 1.

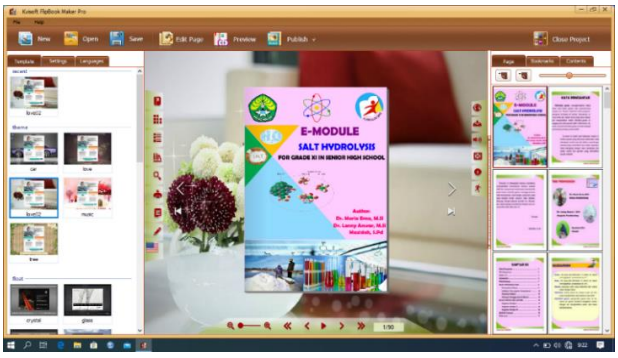

Figure 1. Cover of e-module on salt hydrolysis

3.3. The effectiveness of e-module

The effectiveness aspect of e-module towards misconceptions was seen from the increase of the scores in pretest and posttest by using three-tier multiple choice questions on salt hydrolysis material before and after using e-module. The analysis of the normality test from pretest and posttest classes was conducted by applying the Shapiro Wilk test. The normality test was done to find out whether the data in pretest and posttest were normally distributed or not. These data can be seen in Table 6.

Table 6. Normality test

Group	Kolmogrov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Misconceptions pretest	0.143	33	0.083	0.952	33	0.151
Misconceptions posttest	0.156	33	0.039	0.955	33	0.181

a.Lilliefors Significance Correction

Table 6 demonstrates that the score derived from pretest and posttest for the experimental class had a sig value as much as 0.151 and 0.181 respectively, meaning that the score from the pretest and posttest were normally distributed because the data had sig> 0.05. Thus, data for hypothesis testing was conducted by a T test in which Ha was accepted if the p value (asymp. Sig 2 tailed) was less than the critical research limit as much as 0.05.

Based on the results of t-test, p value was obtained (asymp. Sig 2 tailed) for as much as 0,000, so that the hypothesis decision was Ha accepted. There was a significant increase for grade XI students at State Madrasah Aliyah 1 Pekanbaru before using interactive e-modules and after using e- interactive module on salt hydrolysis material, this can be seen in Table 7.

Table 7. Statistical test

	Levene's Test for Equality Variances		t-test for Equality of Means						
	F	Sig.	T	df	Sig.(2-tailed)	Mean Difference	Std.Error Difference	95% Confidence Interval of the Differnce	
								Lower	Upper
Equal variances assumed	0.874	0.353	-26.661	64	0.000	-49.0909	1.8413	-52.7694	-45.4125
Equal variances not assumed			-26.661	62.067	0.000	-49.0909	1.8413	-52.7716	-45.4103

This study revealed that the e-module was effective to be implemented in the learning process. This was because the application of ICT in a learning field was believed to be able to improve students' learning abilities; one of which was using the e-modules [33]. Applying ICT in the learning process would positively affect students' learning outcomes [34]. Moreover, learning by using media had a positive effect on students' learning outcomes and it could reduce the students' misconceptions because students could directly see the abstract learning through the display of videos and animations on e-modules used in learning [35].

4. CONCLUSION

Based on results and discussion, the p value was (asymp. Sig 2 tailed) 0,000, so that Ha was accepted, meaning there was a significant increase of the students at grade XI in State Madrasah Aliyah 1 Pekanbaru before and after using interactive e-modules on salt hydrolysis material. Furthermore, it also reduced students' misconceptions on salt hydrolysis material. The percentage of misconceptions reduction after using the interactive e-module on salt hydrolysis material at grade XI in State Madrasah Aliyah 1 Pekanbaru was 16.21%.

REFERENCES

[1] Ball, A., Joyce, H. D., and Butcher, D. A., "Exploring 21st Century Skills and Learning Environments for Middle School Youth," *International Journal of School Social Work*, vol. 1, no. 1, pp. 1-15, 2016.

[2] Alismail, H. A and Guire, P. Mc, "21st Century Standards and Curriculum: Current Research and Practice," *Journal of Education and Practice*," vol. 6, no. 6, pp. 150-154, 2015.

[3] Mahajan, R. L., Mueller, R., Reed, J., Williams, C. B., Cambell, T. A., and Ramakrishnan, N., "Cultivating Emerging and Balck Swan Technologies," *ASME Proceeding, International Mechanical Engineering Congress and Exposition*, vol. 45226, 2012, pp. 549-557.

[4] Teo, T., "Pre-service Teacher's Attitude Toward Computer Use: a Singapore Survey," *Australian Journal of Educational Technology*,vol. 24, no. 4, pp. 413-424, 2008.

[5] Abao, E. D. L., Boholano, H. B., and Dayagbil, F. T., "Engagement to Social Networking: Challenges and Opportunities to Educators," *European Scientific Journal*, vol. 11, no. 16, pp. 173-191, 2015.

[6] Rufii and Dyah Rochmawati, "Evaluation of universal design for constructivist-based statistics learning module for students' increased motivation," *Journal of Education and Learning (EduLearn)*, vol. 13, no. 3, pp. 431-440, 2019.

[7] Ali Muhson., "Development of Information Technology-Based Learning Media (*in Bahasa*)," *Indonesian Journal of Accounting Education*, vol. 8, no. 2, pp. 1-10, 2010.

[8] Darmaji, Dwi Agus Kurniawan, Astalini, Wawan Kurniawan, Khairul Anwar, and Artha Lumbantoruan, "Students' perceptions of electronic module in physics practicum," *Journal of Education and Learning (EduLearn)*, vol. 13, no. 2, pp. 288~294, 2019.

[9] Fera Astuti, Tri Redjeki, and Nanik Dwi Nurhayati, "Identification of Misconceptions and Their Causes in Class XI MIA Students of SMA Negeri 1 Sukoharjo Academic Year 2015/2016 on Stoichiometry Material (*in Bahasa*)," *Journal of Chemistry Education*, vol. 5, no. 2, pp. 10-17, 2016.
[10] Nataria Wahyuning Subayani, "The Profile of Misconceptions among Science Subject Student-Teachers in Primary Schools," *International Journal of Education & Literacy Studies*, vol. 4, no. 2, pp. 54-61, 2016.
[11] Ayu Mutmainnah Halim, Halimah Husain, and Sugiarti, "Analysis of the Misconceptions of Class X MIA 4 Students of SMA Negeri 1 Pinrang on Chemistry Bonding Materials Using a Three-Tier Test (*in Bahasa*)," in *Proceedings of the National Seminar on Chemistry*, UNY, 2017, pp. 37-54.
[12] Suwarto, *Development of Diagnostic Tests in Learning Practical Guides for Educators and Prospective Educators* (*in Bahasa*). Yogyakarta, Pustaka Pelajar, 2013.
[13] Pesman, H and Eryilmaz, A., "Development of a Three-Tier Test to Assess Misconception About Simple Electric Circuits," *The Journal of Educational Research*, vol. 103, no. 3, pp. 208-222, 2010.
[14] Syarifatul Mubarak, Endang Susilaningsih, and Edy Cahyono, "Development of a Three Tier Multiple Choice Diagnostic Test to Identify Misconceptions of Class XI Students (*in Bahasa*)," *Journal of Innovative Science Education*, vol. 5, no. 2, pp. 101-110, 2016.
[15] Noor Fathi Maratusholihah, Sri Rahayu, and Fauziatul Fajaroh., "Analysis of High School Students' Misconceptions on Salt Hydrolysis and Buffer Solutions (*in Bahasa*)," *Journal of Education: Theory, Research, and Development*, vol. 2, no. 7, pp. 919-926, 2017.
[16] Mosik and P. Maulana, "Efforts to Reduce the Occurrence of Physics Misconceptions through Learning with a Cognitive Conflict Approach (*in Bahasa*)," *Journal of Indonesian Physics Education*, vol. 6, pp. 98-103, 2010.
[17] Safrida, Cut Ratna Dewi, and Abdullah, "The Use of Animated Modules and Media in Reducing Student Misconceptions on Circulatory System Material in SMAN 5 Kota Banda Aceh (*in Bahasa*)," *Journal of Enlightenment*, vol. 11, no. 1, pp. 39-45, 2017.
[18] Basman Tompo, Arifin Ahmad, and Muris Muris., "The Development of Discovery-Inquiry Learning Model to Reduce the Science Misconceptions of Junior High School Students," *International Journal Of Environmental & Science Education*, vol. 11, no. 12, pp. 5676-5686, 2017.
[19] Fitria, Sigit Priatmoko, and Kasmui, "The Use of Interactive Multimedia in Minimizing Student Misconceptions on the Main Material of Buffer Solutions (*in Bahasa*)," *Journal of Chemical Education Innovation*, vol. 10, no. 1, pp. 1641-1650, 2016.
[20] Maria Erna, Sri Haryati, and Chelsi Hestivik, "Application of the PDEODE Collaborative Strategy (Predict, Discuss, Explain, Observe, Discuss, and Explain) to Reduce Student Misconceptions on the Subject of Solution Balance in Class XI MIA SMA Negeri 1 Pekanbaru (*in Bahasa*)" *Journal of Chemical Education Innovation*, vol. 13, no. 2, pp. 2360-2369, 2019.
[21] Mustofa Abi Hamid, Lely Yuliawati, and Didik Aribowo, "Feasibility of electromechanical basic work e-module as a new learning media for vocational students," *Journal of Education and Learning (EduLearn)*, vol. 14, no. 2, pp. 199-211, 2020.
[22] Nur A. Limatahu, Nurul Aulia Rahman, St. Hayatun Nur Abu, and Indra Cipta., "The Effect of Practicum Videos with Electronic Modules on Process Skills on Stoichiometric Materials for Class X Students of SMAN 2 Tidore Kepulauan (*in Bahasa*)," *Journal of Chemistry Education*, vol. 9, no. 1, pp. 225-228, 2017.
[23] Citra Devi Imaningtyas, Puguh Karyanto, Nurmiyanti, dan Lilik Asriani, "Application of E-MODULE Based on Problem Based Learning to Improve Science Literacy and Reduce Misconceptions in Ecology Material for Class X MIA 6 SMAN 1 Karanganom Academic Year 2014/2015 (*in Bahasa*)," *Journal of Bioeducation*, vol. 9, no. 1, pp. 4-10, 2016.
[24] Fahmi, S., Priwantoro, S. W., Cahdriyana, R. A., Hendroanto, A., Rohmah, S. N., and Nisa, L. C., "Interactive Learning Media Using Kvisoft Flipbook Maker for Mathematics Learning," *IOP Conference Series: The Sixth Seminar Nasional Pendidikan Matematika Universitas Ahmad Dahlan*, vol. 1188, 2019, pp. 1-6.
[25] Susanti, F., "E-Module Development with the Kvisoft Flipbook Maker Application on the Subject of Static Fluid for Class X High School/MA Students (*in Bahasa*)," UIN Sunan Kalijaga, Yogyakarta, 2015.
[26] Firman and Rahman R., "Online Learning Amid the Covid Pandemic 19 (*in Bahasa*)," *Indonesian Journal of Educational Science*, vol. 2, no. 2, pp. 81-89, 2020.
[27] Milman, N. B., *Distance Education. In International Encyclopedia of the Social & Behavioral Sciences: Second Edition*. Elsevier, 2015.
[28] Wiana, W., Barliana, M. S., and Riyanto, A. A., "The Effectiveness of Using Interactive Multimedia Based on Motion Graphic in Concept Mastering Enhancement and Fashion Designing Skill in Digital Format," *International Journal of Emerging Technologies in learning (IJET)*, vol. 13, no. 2, pp. 4-20, 2018.
[29] Sugiyono, *Understanding qualitative research (in Bahasa)*. Alfabeta, Bandung, 2005.
[30] Yudi Kurniawan and Andi Suhandi, "The Three-Tier Test For Identification The Quantity of Student's Misconception on Newton's First Law," in *GTAR Proceeding, Global Illuminators*, Bandung, 2015.
[31] Heni Purnamawati, Puguh Karyanto, Sri Dwiastuti, and Dynna Sri Wulandari, "Efforts to Improve Science Process Skills and Reduce Misconceptions through the Application of Problem-Based Learning E-Module Class X MIA 2 SMA Batik 1 Surakarta (*in Bahasa*)," *Journal of Bio-pedagogy*, vol. 5, no. 1, pp. 32-37, 2016.
[32] Fengky, "Development of e-module combining science process skills and dynamics motion material to increase critical thinking skills and improve student learning motivation senior high school," *International Journal of Science and Applied Science*, vol. 1, no, 1, pp. 45-54, 2017.
[33] M. A. Ramdhani and E. R. Wulan, "The Analysis of Determinant Factors in Software Design for Computer Assisted Instruction," *International Journal of Scientific & Technology Research*, vol. 1, no. 8, pp. 69-73, 2012.

[34] M. A. Ramdhani and H. Muhammadiyah, “The Criteria of Learning Media Selection for Character Education in Higher Education,” in *International Conference of Islamic Education in Southeast Asia*, Malang, 2015, pp. 174-182.
[35] I. Farida, "The Importance of Development of Representational Competence in Chemical Problem Solving Using Interactive Multimedia," in *International Seminar on Science Education*, Bandung, 2009.

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